

Appl. No. 10/810,804
Amendment dated: June 9, 2006
Reply to OA of: March 9, 2006

REMARKS

This is in response to the Official Action of March 9, 2006. Applicants have amended the claims, taking into consideration the outstanding Official Action.

Specifically, Applicants have amended claims 1 and 4 to recite that the borophosphosilicate glass layer and the borosilicate glass layer together form a composite hard mask for forming deep trenches, with the borophosphosilicate glass layer serving as a strip layer for the composite hard mask. Support for these amendments may be found throughout the specification as originally filed, including, e.g., page 8, lines 10-23.

Applicants have also added new claims 5 and 6. New claim 5 recites that the method of claim 1 further comprises forming an un-doped silicate layer on the borosilicate layer before forming the deep trenches. Support for this amendment may be found throughout the specification as originally filed, including, e.g., page 7, lines 15-17. New claim 6 recites that the method of claim 1 further comprises the step of completely removing the borophosphosilicate glass layer and the borosilicate glass layer after the deep trenches are formed. Support for this amendment may be found throughout the specification as originally filed, including, e.g., page 8, lines 10-23.

Applicants respectfully submit that all claims now pending in the instant application are in full compliance with the requirements of 35 U.S.C. §112 and are patentable over the references of record.

The rejection of claims 1 and 4 under 35 U.S.C. §103(a) as being unpatentable over Beintner et al. (US Pat. No. 6,933,206) has been carefully considered but is most respectfully traversed in light of the following comments.

Applicants wish to direct the Examiner's attention to the basic requirements of a prima facie case of obviousness as set forth in the MPEP § 2143. This section states that to establish a prima facie case of obviousness, three basic criteria first must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a

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reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Section 2143.03 states that all claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

Applicants also note MPEP §2143.01, which states in part that, if a proposed modification would render the prior art invention unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. In re Gordon, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

Applicants also most respectfully direct the Examiner's attention to MPEP § 2144.08 (page 2100-114) wherein it is stated that Office personnel should consider all rebuttal argument and evidence presented by applicant and the citation of In re Soni for error in not considering evidence presented in the specification.

The Official Action urges that Beintner discloses a substrate 200, a pad oxide layer 201 formed on the substrate and a pad nitride layer 203 on the pad oxide layer. The Official Action further urges that Beintner discloses forming a hard mask layer or layers on the structure so as to more efficiently etch trenches 202b and that the reference discloses that the hard mask layer or layers may be composed of BPSG, BSG, FSG, PSG or the like and amorphous silicon layers.

The Official Action expressly acknowledges that there is no disclosure in Beintner related to the specific order of the hard mask layers and why one would use BSG and BPSG of all the materials listed. However, the Official Action urges that applicants have not indicated any criticality for the various materials and the order of

materials and therefore the mere selection of known masking materials and their order would have been obvious to one of ordinary skill in the art through routine experimentation. Applicants specifically traverse this statement, as the criticality of the order of layers and type of materials used is expressly set forth throughout the specification as originally filed.

The criticality of the recited order and selection of material for the hard mask layers is first set forth on page 5, lines 8-17. This portion of the specification states that upon an annealing step, most of the boron in the borophosphosilicate glass layer will diffuse upward and into the borosilicate glass layer, while very little of the phosphorus in the borophosphosilicate glass layer will diffuse upwards. The abundance of phosphorus remaining in the borophosphosilicate glass layer enables the borophosphosilicate glass layer to be easily and completely removed from the semiconductor substrate. Because the borosilicate glass layer is formed on top of the borophosphosilicate glass layer, easy removal of the borophosphosilicate glass layer also allows for easy removal of the borosilicate glass layer.

Thus, the specific selection of these materials and the order of the layers is critical to the presently claimed invention since the specific materials and order of the layers is what causes the method of the instant application to accomplish one of the stated objectives, i.e., easy and complete removal of the hard mask after formation of deep trenches (see, e.g., page 4, lines 4-6).

This point is further explained at page 8, lines 10-23 of the originally filed specification. Recitation of BSG and BPSG and their specific order in the instant claims is critical to the claimed invention because reducing the amount of boron and maintaining the amount of phosphorus in the BPSG layer after annealing allows for easy and complete removal of both the BPSG and BSG layers that make up the hard mask. That is, the use of a BSG layer deposited on a BPSG layer allows the BPSG layer to serve as a "strip layer" for the composite hard mask to facilitate easy removal of the entire hard mask. Different materials deposited in a different order would not achieve this result.

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Applicants have amended the claims to more precisely define this feature of the claimed invention. Claims 1 and 4 now clearly recite that the BPSG and BSG layers form a composite hard mask and that the BPSG serves as a strip layer for removing the hard mask after formation of the deep trenches.

The Beintner reference fails to address the issue of selecting certain materials and the order of the layers in a composite hard mask to allow for easier removal of etch mask layer. This is expressly acknowledged in the Official Action when it is stated that "Beintner does not teach the specific order of the layers and why one would use the BSG and BPSG out of the others." Beintner merely recognizes that a etch mask layer may comprise a layer or layers of BSG, BPSG, PSG and FSG, but provides no disclosure, suggestion or motivation for which materials should be selected and in what order they should be deposited.

As the originally filed specification clearly sets forth the criticality of forming a BPSG layer followed by a BSG layer, Applicants respectfully submit that selection of the materials and order of layers is not obvious as a matter of routine experimentation. Failure to use BPSG and BSG in the order recited in the claims would undermine an express objective of the instant application, as the ability to easily and completely remove the composite hard mask would be frustrated. Accordingly, Applicants respectfully submit that Beintner fails to properly support a §103(a) rejection according to the guidelines set forth in MPEP §2143 and should therefore be withdrawn.

The rejection of claim 2 under 35 U.S.C. §103(a) as being unpatentable over Beintner as applied to claims 1 and 4 and further in view of Shimonishi et al. (US Pat. No. 6,303,466) and the rejection of claim 3 under 35 U.S.C. §103(a) as being unpatentable over Beintner as applied to claims 1 and 4 and further in view of Applicants' admitted prior art have been carefully considered but are most respectfully traversed in light of the following comments.

As discussed in detail above, Beintner fails to disclose or suggest every element of claims 1 and 4 and is therefore incapable of properly supporting a §103(a) rejection according to the guidelines set forth in MPEP §2143. Accordingly, as the rejection of


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claims 2 and 3 over Beintner depend on the faulty rejection of claims 1 and 4 over Beintner, Applicants respectfully submit that the rejection of claims 2 and 3 are deficient for the same reasons as discussed above with respect to the rejection of claims 1 and 4 over Beintner. It is therefore respectfully requested that the rejection of claims 2 and 3 also be withdrawn.

Further, Applicants note that none of the secondary references cited in the Official Action remedy the deficiency in Beintner identified above. Neither Shimonishi nor Applicants' admitted prior art disclose or suggest forming a BPSG layer followed by forming a BSG layer on the BPSG layer to form a composite hard mask, wherein the BPSG layer serves a strip layer after the annealing step. Accordingly, because neither Beintner, Shimonishi nor AAPA, either standing alone or when taken in combination, disclose or suggest every element of the instant claims, Applicants respectfully submit that a proper §103(a) rejection according to the guidelines set forth in the MPEP §2143 has not been established. Applicants therefore respectfully submit that all the rejections based upon these references be withdrawn and the instant application be allowed.

In view of the above comments and further amendments to the claims, favorable reconsideration and allowance of all of the claims now present in the application are most respectfully requested.

Respectfully submitted,
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